Trophic Cascades in the Ocean: The Interaction Between Zooplankton and Pelagic Fish on Georges Bank

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Abstract

We compared trends in abundance of major planktivores on Georges Bank, the Atlantic herring *(Clupea harengus)* and the Atlantic mackerel (*Scomber scombrus*), with zooplankton abundance from the 1970s to present. Pelagic fish abundance declined in the late 1960s and early 1970s due to overfishing and did not begin to recover until the mid 1980s. In the 1990s both Atlantic herring and Atlantic mackerel abundance exceeded that in any of the past thirty-five years. Total zooplankton numbers and biomass on Georges Bank declined from the 1970s to a low in the 1980s, and subsequently increased in the 1990s. Examination of dominant zooplankton species revealed that the abundance of three major copepods, *Calanus finmarchicus*, *Centropages hamatus*, and *Centropages typicus*, similarly increased in abundance during the 1990s concurrent with the recovery of these pelagic fish, although *Pseudocalanus* spp. declined. Atlantic herring and Atlantic mackerel food habits demonstrated an increase in the amount of copepods in the diet during the 1990s. Other zooplankton vary in importance in the diet with no clear trend. We conclude that it is unlikely that Atlantic herring or Atlantic mackerel regulate zooplankton populations or have altered the Georges Bank zooplankton community. Alternatively, it is probable that, in addition to less directed fishing pressure, the increase in copepod abundance has helped pelagic fish recruitment and growth, ultimately contributing to the record high abundances of Atlantic herring and Atlantic mackerel. Regardless of knowing the ultimate causality, bottom-up processes are currently the dominant influences on the Georges Bank pelagic food web.

KEYWORDS: top-down, bottom-up, trophic ecology, food web dynamics, ecosystem considerations, large marine ecosystems